"high," while a woman's voice is low.[15] Accordingly, they 'jump up' to a lower note and call the lowest lute string *hamm*, the "highest."

The original meaning of "higher" in the Semitic Orient was not, as with us, "at a greater altitude," but "taller," just as the tallest organ pipes produce the lowest notes.

[15] Eberhard Hommel, *Untersuchungen zur hebräischen Lautlehre*, Leipzig, 1917, p. 47.

[3]

MUSIC IN THE ANCIENT WESTERN ORIENT

ON EGYPTIAN RELIEFS and wall paintings, music is mostly connected with those scenes from the lives of the great that the artists depicted in order to facilitate, indeed to enforce, bliss and pleasure in a future existence of the dead. Banquets with singers, players, and dancers are much more frequent than temple ceremonies. (Pl. 2, p. 65)

Kneeling players are plucking harps or blowing pipes while singers face them, the better to keep in time. Many of these ensembles are actual orchestras; there are seven harps and seven flutes on one relief. This is an important evidence, since it suggests that in many scenes the artists might have reduced the number of participants merely for lack of space. Instrumental orchestras without singers were obviously not yet considered.[16]

The chief instruments were the often beautifully adorned harps. We would not know how they were tuned but for a single word hidden in an unexpected source: the *Jewish Antiquities* of Flavius Josephus, the Jewish historian and general, written in the first century A.D., defines the Egyptian harp as an *órganon trígonon enarmónion* used by temple harpists (*hieropsaltai*). The Egyptian harp was enharmonic.

There cannot be any mistake about this evidence. The enharmonic tetrachord, as the Greeks understood it, was composed of a *major* third and a semitone; the term also applied to a heptad of two such tetrachords conjunct, or to an octave of two such tetrachords disjunct. The later Greeks split the semitone into two microtones; but this 'modern' variety is not to be considered in Egyptian temples with their tradition of thousands of years. The scale, consequently, was approximately *A F E C B*, with as much repetition through higher and lower octaves as the number of strings permitted.

This means that the Egyptians had the same archaic scale that the Greeks honored as their earliest genus and that the Japanese have preserved to this day.

Lyres, which appeared in Egypt in the fifteenth century B.C., that is,

[16] Cf. the illustrations in Curt Sachs, *Die Musikinstrumente des alten Aegyptens*, Berlin, 1921, Figs. 73, 76, 109, 109*a*, 112.

Title confirmed by Hickmann.

about twelve or thirteen hundred years later than harps first appeared on reliefs, can hardly be supposed to have followed the same genus of major third pentatonics. Josephus expressly called the harps enharmonic, but not all Egyptian music. And then, all lyres of which we know the tuning, in ancient Greece as well as in modern Nubia and Ethiopia, have been submitted to the usual pentatonic genus with minor thirds, that is, *E G A B D*, continued upward and downward according to the number of strings.

We can hardly be mistaken in assuming that the ancient harpists and lyre players had to rely on their ears just as modern harp, piano, and organ tuners do; and the ear applies three innate standards: the intervals of the octave, the fifth, and the fourth. Starting from a medium note that fitted the singer's voice, the ancient players must have tuned another string to its fifth; a fourth backward from this provided the second above the starting tone. Or else the other way around: a fourth up and a fifth back would provide the second below the starting tone. This is not just a circle or cycle of fifths, as it is generally called, but a continual, indeed cyclic, rising and falling, as $\frac{g}{c}\,\frac{a}{d}$. The *cyclic principle* might be an appropriate short name for it, or, less formally, the *up-and-down principle*.

* * *

Pipes followed a different law. Their scales depended on the relative position of fingerholes; and this arrangement was determined by measures of length, that is, by feet and inches, not by any musical conception. I have discussed the general principle in my *History of Musical Instruments* [17] and need not repeat its details except for the main point: "Most pipes, both primitive and highly developed, have equidistant fingerholes. But this equidistance absolutely precludes the production of any musical scale unless the notes are corrected by the size of the holes, the breath, the fingering, or some special device."

Unfortunately, the many pipes depicted on Egyptian and Sumerian art works are not distinct enough to yield exact measurements. But a sufficient number of real pipes have been excavated in both countries to give us this information:

Of two Egyptian flutes from a tomb of the Middle Kingdom (c. 2000 B.C.) [18] one, though cut without much care, 95 cm. long, has fingerholes

[17] *Op. cit.*, pp. 181 f.
[18] J. Garstang, *The Burial Customs of Ancient Egypt*, London, 1907, pp. 154 ff.

at ten, eleven, and thirteen fifteenths of its entire length; and the other, only 90 cm. long, at eight, nine, and ten twelfths. The scale of the first flute was *theoretically* 15:13, 13:11, 11:10, or 248–289–165 Cents; of the second flute, 12:10, 10:9, 9:8, or 316–182–204 Cents. Each had the range of a fifth (702 Cents), and the smaller one was correctly subdivided to form a pentatonic pentachord. Actually, the insufficient width of the holes and the interference of the pipe below the hole flattened the notes beyond control—the higher notes more than the lower ones, since a longer part of the pipe interfered with the theoretical pitch. I repeat: the theoretical pitch.

From early Sumeria (c. 2700 B.C.) we possess two slender oboes in the University Museum at Philadelphia. One, with four fingerholes, is broken and must be disregarded; the other, with only three holes, is arranged in the ratios 10:9:8:7, that is, approximately in whole tones (182–204–231 Cents).

Egyptian pipes of the last two thousand years B.C. were not essentially different. Despite their variability and the shrinkage unavoidable with so delicate a material, the principle of equipartition is unmistakable. The steps from hole to hole approximate whole tones and semitones, and the position of the highest hole, in the middle of the lower half of the pipe, indicates that these oboes, too slender to yield the ground tones, normally produced the higher octave and, by overblowing, the fifth above.[19]

* * *

Equipartition, the obvious principle in arranging the fingerholes of pipes despite much carelessness and also much intentional variation, needed all kinds of compensation to be musically acceptable. With strings, on the contrary, equipartition became a sound basis of tone generation that rightly might be called both natural and scientific.

Division of strings, meaningless with harps, which for every note had an individual, 'open' string, was imperative where all notes had to be produced on one or two strings by instantaneous changes of the vibrating lengths. This was done by stretching the string for a short distance along a stick or board, against which it was pressed by one of the left-hand fingers, thus bounding the vibrating length of the string. In stopping—as this is called—the hand was guided by *frets*, which in Western antiquity were loops tied about the fingerboard at the given points.

[19] In the museums at Leyden, the oboes nos. 475 and 477—12:9:8:7:6 twelfths; Torino no. 8 and Berlin no. 20667—12:11:10:9:8 twelfths; Torino no. 12—14:12:11:10:9:8:7 fourteenths; Torino no. 11—11:10:9:8:7:6 elevenths.

Stopped instruments first reached Egypt in the fifteenth century B.C. on their way from Asia—together with oboes. They belonged in the family of *long lutes*, in which the stick was much longer than the tiny body.

The earliest serviceable evidence of a fingerboard is the mural painting, in Nakht's tomb at Thebes in Egypt (fifteenth century B.C.), of a lutanist who plays a West Asiatic lute with nine frets on its long neck. The distinctly drawn frets were tempting enough to stimulate imagination; so my late friend Dr. Erich M. von Hornbostel endeavored to measure the distances between the ligatures and to translate them into musical Cents.[20] The eminent scholar seems, however, to have gone too far in interpreting and even emending the data of that painting; Egyptian art works, though fairly accurate, cannot be expected to stand a complicated mathematical test. Besides, Hornbostel's scale rested on an obvious mistake. The first and highest ligature means a stopping place only on instruments with a pegbox that meets the fingerboard at a certain angle, such as the modern violin, on which the little ebony ridge at the upper end of the fingerboard determines the beginning of the vibrating section of the string. The Egyptian lute had neither pegs nor a separate headpiece. Consequently, the strings, which were simply attached by cords tied around the upper end of the stick, needed one first ligature to raise them from the fingerboard and secure free vibration; the sounding length of the string began only with this first ligature, and it was the *second* ligature that marked the first stopping place.

This gives a different picture. The string is divided into two halves; the upper half is again divided into thirds and quarters; the first quarter is split in two, and a fifth quarter is fretted beyond the middle of the string. Thus the frets follow two superimposed arithmetic progressions, one in sixths and the other in eighths of the whole, providing a scale in which at least the lowest tetrachord is chromatic. Any more detailed discussion would be guesswork, the more so as on fretted instruments pitch does not vary in quite exact proportion to the sounding length. Essential here, however, is the general principle that not the ear but *equipartition* of a string decides the scale (Pl. 1, p. 64)

Equipartition on lutes was not unparalleled. A pre-Islamic long lute from Bagdad had its strings divided into forty equal parts,[21] of which only the upper five were used and marked by frets. Since the sections were

[20] E. M. von Hornbostel, "Musikalische Tonsysteme," in H. Geiger und Karl Scheel, *Handbuch der Physik* VIII, Berlin, 1927, p. 435.

[21] For the number 40, cf. Wilhelm Heinrich Roscher, "Die Zahl 40 im Glauben, Brauch und Schrifttum der Semiten," in *Abhandlungen der philologisch-historischen Klasse der Kgl. Sächsischen Akademie der Wissenschaften* XXVII (1909), pp. 91–138.

but tiny in comparison with the full length, the tonal distances were practically equal quarter tones.

Later examples of equipartition into twelve in the Near East were based on the fact that twelve is the common denominator of the fractions that designate the three intervals innate in man: the octave 1:2, the fifth 2:3, the fourth 3:4. Pythagoras, according to Gaudentios' *Isagoge*, divided his *kanón* or monochord into twelve parts. In the second century A.D., the Greco-Egyptian Ptolemy followed him, when he recommended his tetrachord *diatonikòn homalón*, produced by the frets zero, one, two, and three of a lute string divided into twelve equal parts: eleven twelfths resulted in a three-quarter tone, ten twelfths in a minor third, and nine twelfths in a fourth. The Arabian theorist, Safi al-Din, described exactly the same principle as being consonant and much used.[22] It still is at the bottom of most Islamic scales.

* * *

Dividing a string by equipartition was not the only, and not even the most usual, system. True, twelve equal parts were in some measure satisfactory since they allowed for just octaves (12:6), fifths (12:8), fourths (12:9), and minor thirds (12:10). But the other stops, such as 12:11 or 12:7, were musically unsatisfactory.

As a consequence, lutanists did what pipers did not dare to do: they replaced the inappropriate arithmetic progression of frets, with its equal distances between tones, by a geometric progression, with its proportionately increasing distances. Struck by the fact that stopping at one half, one third, and one quarter of the entire length resulted respectively in the three principal intervals, they logically went a step further and accepted the stopping at one fifth of the string as producing the major third and that at one sixth as producing the minor third.

We call this victorious principle *divisive*.

Both the divisive principle and the up-and-down principle, already discussed, being natural themselves, yielded 'natural' scales. But only their octaves, fifths, fourths, and certain whole tones agreed; in divisive scales, the major third was smaller and the semitone larger, while the whole tone came in two different sizes.

A few fractions will easily show the reason. The first whole tone, say from *C* to *D*, is found (just as in following the up-and-down principle)

[22] Carra de Vaux, *Le traité des rapports musicaux par Safi ed-Din*, Paris, 1891, pp. 308–17.

by deducting a fourth from a fifth, that is, *C–D* is *C–G* minus *D–G*. This is done by *dividing* the ratio of the fifth, 3:2, by the ratio of the fourth, 4:3, the result (according to the rule of crosswise multiplication of fractions) being 9:8 for the whole tone.

The following whole tone *D–E*, however, is the difference between the major third *C–E* (5:4) and the whole tone just found (9:8), or, dividing the ratios as above, 40:36, or, reduced, 10:9. It is smaller than the whole tone *C–D*.

This distinction between whole tones is impossible where the scale is provided by a cycle of fifths and fourths, for there every whole tone results from a rising fifth (*C–G*, *D–A*, etc.) and a falling fourth (*G–D*, *A–E*, etc.) and is therefore invariably 9:8.

In the cycle of fifths and fourths, consequently, the major third follows not the ratio 5:4, as in the divisive system, but (adding two equal whole tones) that of 9:8 *multiplied* by 9:8, or 81:64, which exceeds the divisive ratio 5:4 (or 80:64) by the so-called Didymian (or syntonic) comma.

Finally, the difference in size between the two major thirds involves also a difference in size between the two semitones of the two systems, the semitone being the difference between the fourth (*C–F*) and the major third (*C–E*). Since the divisive third is smaller, the semitone left over when it is deducted from a fourth must be larger:

Up-and-down	Major tone	Major tone	Semitone
Divisive	Major tone	Minor tone	Semitone

The equivalents in Cents for the intervals derived from the two systems are:

One perfect fifth:		702
One perfect fourth:		498
Two major thirds:	Cyclic	408
	Divisive	386
Two minor thirds:	Cyclic	316
	Divisive	294
Two whole tones:	Cyclic and Divisive	204
	Divisive	182
Two semitones:	Divisive	112
	Cyclic	90

A REMARKABLE and somewhat unexpected evidence of this contrast between the divisive and the up-and-down principles is the slight divergence in an otherwise analogous musicocosmological conception in Babylonia—of which Plutarch speaks about 100 A.D.[23]—and in China. Both civilizations connaturalized the intervals between the four seasons of the year and the simplest musical intervals. The connotation (starting, say, from *C*) reads (upward) in

CHINA	BABYLONIA
	C' Summer
Winter	*G* Winter
Autumn	*F* Autumn
Summer	*D*
Spring	*C* Spring

There is agreement except for the position of the summer. Why? Here, I think, is the reason: the Chinese arrangement follows a cycle of fifths or fourths (*F, C, G, D* or *D, G, C, F*) and the Babylonian, the division of a string into ground tone (1:1), octave (1:2), fifth (2:3), and fourth (3:4). Thus the same philosophical idea materializes, with a difference that is characteristic of each system, in the up-and-down principle in China, the typical country of the cycle of fifths and fourths, and in the divisive principle in Babylonia, earliest home of the fretted long lute.

PARTIALS OR 'OVERTONES' as the natural route markers, a pet idea of some writers who try to offer a 'plausible' theory of scale formation, should be entirely eliminated from our order of thought. To the extent that they appear as the overblown notes of wind instruments, they would indeed be poor standards; wild-grown animal horns and reed pipes yield sensibly false octaves and fifths, and even instruments of higher workmanship depend on their wider or narrower bores. *Partials*, in the proper sense of the word, that is, covibrations of a note played or sung, are difficult to hear and were hardly considered before the later Middle Ages. Even in India, the theoretician Sārngadeva discovered the second partial, that is, the harmonic octave, as late as the thirteenth century, and three hundred more years elapsed before Rāmāmātya heard higher harmonics and used them

[23] Plutarch, "De anim. procr.," in *Timaeus* 31.

in arranging the frets of his vīṇā.[24] The idea that musicians of antiquity, indeed of primitive epochs, would have taken their notions of octaves, fifths, and fourths from the short vibrations of plucked harp or lyre strings is truly inadmissible.

To be sure, these 'harmonics' were perfect and represented the ideal intervals of all systems, at least down to the fourth. But they did so only for the simple reason that they originated from exactly the same vibrations of the half, the third, the fourth parts of the string as the notes produced in following the divisive principle. They were a parallel, not a creative, phenomenon.

* * *

The singers represented on Egyptian pictures bring their left hands to their left ears in a gesture familiar to many Oriental singers of ancient and modern times; the wrinkles, particularly between the eyebrows, indicate nasal singing from a compressed throat and probably at a high pitch.

The right arms are even more fascinating: the singers communicate with their accompanists by stretching out the right forearms and performing a few stereotype gestures; they turn the palm upward[25] or the thumb upward,[26] bend the thumb against the forefinger[27] or turn the palm downward.[28] (Pl. 2*b*, p. 65)

Exactly the same thing has been done in India: Hindu singers silently beat time by lifting the forearm, turning the palm either up or down, and stretching or doubling up the fingers.

Audible time beating was known in Egypt as well: the tomb of Amenemhêt at Thebes (soon after 1500 B.C.) depicts a conductor, standing before and facing the performers, pounding time with his right heel and snapping both his thumbs and forefingers.[29]

And this, too, is paralleled in India: leaders bring the thumbs against the forefingers and snap, either with the right or the left hand, or even with both.

The singers' melodies, however, cannot be read from murals. In Egypt

[24] N. S. Ramachandran, "The Evolution of the Theory of Music in the Vijayanagara Empire," in *Dr. S. Krishnaswami Aiyangar Commemoration Volume* (1936), pp. 396 f.
[25] Cf. the illustrations in Curt Sachs, *Die Musikinstrumente des alten Aegypten, op. cit.*, Fig. 86 from the 5th Dynasty.
[26] Fig. 110 from the 5th Dynasty, and Fig. 109 from the 12th Dynasty.
[27] Fig. 109*a* from the 5th Dynasty.
[28] Fig. 76.
[29] Fig. 9 from the 18th Dynasty.

and Sumeria vocal music was just as little concerned with rigid systems as it was elsewhere; the freedom granted to unaccompanied singers eliminated the question of shade, if not of mode. No deduction from instruments gives the remotest idea of vocal styles in the ancient Western Orient. But there are several indirect means of approach that do.

* * *

Jewish music is the best gateway to the vocal style of the ancient Western Orient, since in spite of unavoidable variation it has lived for four thousand years without any interruption.

No Jewish music was recorded in ancient times, to be sure; the melodies were orally transmitted from generation to generation. Still, the late Abraham Z. Idelsohn, Professor at the Hebrew Union College in Cincinnati, has opened an indirect way to the old music of Israel: he found the exact counterparts of several Gregorian melodies in remote Jewish congregations, in Yemen, Babylonia, and Persia, which were separated from Palestine and the further development of Jewish ritual music after the destruction of the First Temple (597 B.C.) and the Babylonian Exile. Consequently, these melodies must have existed in the homeland before 600 B.C.

We are less fortunate with other melodies. The Jewish people has been dispersed for twenty-five hundred years and has crystallized in three groups: Orientals in the Middle East, Sephardim in the Mediterranean, Ashkenazim in the rest of Europe. Their liturgical melodies are quite different; not even the most essential parts of the musical service agree (just as in the Ambrosian and Gregorian versions of the Catholic Church music). And yet the basic style is the same and therefore must be an old heritage from times before the dispersion.

* * *

The old heritage is best preserved in the liturgy of the Oriental Jews, who have lived uninterruptedly in the Near and Middle East, and who have never allowed worldly music to enter the synagogue, nor let their cantors improvise. To be sure, such stagnation implies the risk of decadence. But the Jews of Yemen, Mesopotamia, Persia, and Buchara seem to have escaped degeneration. Otherwise their cantillation could not be so strik-